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THE HAND AS AN UNRULY MEMBER.

BY BURT G. WILDER, M. D.

[Continued from page 423.]

IN the first part of this article, taking for granted that all readers of the *NATURALIST* are aware that the mammals have two pairs of limbs, of which the hinder are generally called legs, while the anterior are either legs or wings or flippers or arms, according to the use their owners make of them, I made the following statements: 1. That, in spite of great differences in appearance and in the movements which they perform, there is a close anatomical resemblance between the human arm and the foreleg of beasts, the wings of birds, the flippers of seals, etc. 2. That there is a similar resemblance between the leg of man and the hinder limbs of animals. All this is now generally admitted, and, however distasteful may be the actual comparison between the limbs of the bear or of the monkey and our own, we cannot help seeing, that when we get upon all-fours like the one, or stand semi-erect like the other, our limbs really occupy partly the same position in regard to our back-bone as do those of the creatures first mentioned: and I might add, that there is a time in the early stages of growth of all vertebrates, when the limbs are just beginning to form, and are mere little fleshy buds or pads projecting from the sides of the body. (Fig. 6, Plate 12.)

This kind of comparison between the fore or hind limbs of different species is called the study of Homologies, and formerly constituted the whole of Comparative Anatomy. But I also stated that within the past century there has arisen a new kind of Comparative Anatomy, which has for its object the comparison, not of corresponding

parts in *different* animals, but of corresponding parts in *one and the same animal*; in short, the human arm is compared, not with the foreleg of a quadruped, but with the human leg: and in like manner the fore and hind legs of a beast are compared with each other.

And, lastly, I stated that it is now pretty well agreed that in this comparison the shoulder and pelvis represent each other; that the humerus and femur are similar parts in the two limbs; that the elbow and the knee, the forearm and the leg do in some way correspond with each other; and that, finally, the foot is, as a whole, the humble representative of the hand. Yet there is a very wide difference of opinion as to whether or not the great toe is the counterpart of the thumb; and this because the rotation which takes place in the forearm allows the thumb to come into two different positions.

If you will take the trouble to place your hand upon the table, the palm downward, and the fingers pointing forward, you will see that the thumb comes upon the *inner* side of the hand, that is, toward the middle line of the body, as does the great toe in the foot; but if you *supinate* the hand and place it on the edge of the table so that the fingers point backwards, the palm facing downward and forward, you will see that the thumb now comes on the outer side of the hand, and is opposite the little toe.

You will say at once and truly, that the former is the easier and more natural position, and coincides more nearly with your previous ideas respecting the thumb and the great toe, and it might perhaps do very well if the hand and the foot were the only parts concerned; but unfortunately the arm and the leg must also be taken into consideration, and whatever principle we adopt for the former, ought to apply equally well to the latter.

Now what idea is suggested when we compare the hand and the foot in the manner first described? The whole foot points forward, and the sole faces downward and backward; the hand and fingers also point forward, and the palm faces downward and backward: at once we say the corresponding parts point in the same direction, they are *parallel* with each other; and if the hand and foot are parallel, why, of course, the other corresponding parts in the two limbs are or ought to be so too.

But here comes the difficulty. The other segments of the limbs are *not* parallel, but the contrary; the thigh points forward, and the upper arm backward; the convexity of the knee looks forward, while the elbow projects backward; the forearm and the leg likewise point, not in the same, but in exactly opposite directions.

The upper parts of the limbs, then, suggest *antagonism* or *oppositeness*; the hand and the foot suggest *parallelism*.

Which shall yield to the other? Shall the upper segments of the limbs be so turned or twisted or viewed as to conform to the idea of parallelism, or shall the hand be supinated and the fingers made to point backward so as to be in antagonism with the foot? This, as was said, brings the thumb on the outer side, and so into relation with the little toe. To this, the thumb objects, and the whole controversy rests between those who favor it exclusively, and those who are willing to pay some regard to the other portions of the limbs.

The former lay great stress upon the functional superiority of the thumb, upon its size and strength, and upon its constant usefulness at every age, from infancy to the time when the man has leisure to reflect upon its wonderful powers and the prominent part it takes in all the operations of the hand; and in view of all this, they urge

that the thumb should be allowed to associate in this comparison with the largest and strongest of the foot's fingers, at any sacrifice on the part of the upper and less conspicuously useful segments of the arm. But the latter believe that the above considerations do not apply in this kind of comparison, and offer facts and arguments (which will be given in another place) to show why the thumb should not be the only part thought of in this connection, and even that it ought to content itself with whatever position as regards the toes may be most convenient for the upper portions of the limb which supports it.

The former uphold one organ against many, and might for that reason be styled the aristocratic party, but for the somewhat incongruous fact, that at the present stage of the controversy, they far outnumber the more democratic members of the other party, who believe in more equal rights for all the parts of the limbs.

So more appropriate titles may be derived from the two ideas which we have found to be suggested, as the thumb is or is not the first part considered in comparing the hand with the foot. If it is, then Parallelism is the idea, and its advocates are the Parallelists. If not, then Antagonism is the idea, and its advocates are the Oppositists.

Among the Parallelists the more prominent in this discussion are Vicq d'Azyr, Bourguery, Cuvier, Flourens, Cruveilhier, Turenne, Owen, MacIise, Martins, Huxley, Mivart,* and Cleland;† to which list might be added the names of as many more anatomists, who have declared themselves more or less decidedly in favor of one or another of the views advanced by those whose names are given.

Those who have more or less completely adopted the

*Anatomy of *Echidna Hystrix*. Transactions of Linnæan Society, Vol. XXV. p. 400.

†Quain's Anatomy. Seventh Edition, 1886. pp. 115-117.

idea of Antagonism are Oken,* Gerdy, Agassiz,† Humphrey, Wyman,‡ Foltz,§ and Dana,* with which small number the writer has the honor to be associated.

THE PARALLELISTS. The ancient anatomists contented themselves with pointing out certain obvious correspondences as to general appearance, as those between the bone of the upper arm and that of the thigh, between the knee and the elbow. Their prudent example is still followed by those who do not care to involve themselves in a controversy, and who find it easier to adopt, unquestioned, the opinions of a predecessor; and, in spite of errors and inconsistencies, this method had generally the merit of non-interference with Nature, and may, in medical language, be styled the *expectant* plan of treatment. But a large and distinguished majority of investigators seem to have made up their minds beforehand that something was out of the way, and, in their endeavors to rectify the supposed disordered state of the limbs, have pursued a more heroic course of treatment which, from the various methods employed, may be divided into *dislocation* and *reversion*, *fracture* and *torsion*; or, as their advocates might say, since in their opinion the Creator had already inflicted the above-named injuries upon their unhappy patients, *reduction*, *setting*, and *untwisting*.

Dislocation with reversion and substitution. The first to "resolutely undertake and seriously discuss the problem of the comparison between the extremities in man and

*The positions of Oken and of Dana upon this question are peculiar, and will be explained farther on.

†Agassiz and Gould's *Principles of Zoölogy*. 1848. p. 65.

‡On anterior and posterior symmetry in the limbs of animals. *Proceedings Boston Society of Natural History*. June 6, 1860; and June 5, 1867.

§Homologie des Membres pelviens et thoraciques de l'homme. *Journal de la Physiologie*. Tome VI. pp. 49-81, and 379-421. April, 1863. The works of all the other authors are cited by Mivart, as in the work already cited, p. 395, and by Martins, *Nouvelle Comparaison des Membres pelviens et thoracique*, etc. *Mems. de l'Acad. des Sciences de Montpellier*. Tom. III. p. 473.

animals," was Felix Vicq d'Azyr, who published a memoir upon the subject in 1774, four years prior to his election as the successor of Buffon, in the French Academy.

He began his comparison by detaching the right arm (Fig. 2) from the shoulder, and placing it by the side of the leg (Fig. 1). He does not specify the position of the hand in this first comparison, but we must conclude that it was *pronated* so as to face the palm backward like the sole, and to bring the thumb (Po) upon the inner side opposite the great toe, both because this was the universal method of viewing them, and because otherwise the idea of parallelism would hardly have suggested itself at all.

Perceiving the resemblance of the elbow (O) to the knee (Pa), and thinking that, being similar parts, they must face in the same direction, he turned the arm around so that the elbow pointed forward, the hand being left as it was (Fig. 3); the two bones of the forearm (U and R), before crossed, became parallel with each other, the thumb, of course, remaining opposite the great toe.

But although the lower portions of the two limbs were thus in harmonious agreement, the anatomist, on examining their upper ends, perceived that, while the smooth articular surface (Fig. 1, Hd) of the thigh-bone was looking *inward* and toward the middle line of the body, the corresponding surface (Fig. 3, Hd) of the humerus, by which it is attached to the shoulder-blade, was looking in exactly the opposite direction.

What was to be done? If he left things as they were, then the heads of the two upper bones set their faces against his idea of parallelism in the most uncompromising manner; while if he restored them to their original condition, the elbow and the knee came into direct oppo-

sition with the idea and with each other at the same time. To avoid both horns of this dilemma seemed at first impossible; but suddenly it occurred to him to drop the unconformable arm, and to try its fellow of the opposite side; and now, upon placing the *left* arm (Fig. 4) by the side of the right leg, and turning it as before so that the elbow pointed forward like the knee, the two bones of the forearm remaining parallel with each other, he was rewarded for his ingenuity by seeing the articular surfaces of the humerus and femur both looking inward. With this very artificial arrangement he seems to have been satisfied, and dismisses the subject with the remark, that "the correspondences of the fingers with the toes are so evident that it is unnecessary to enumerate them"; either not perceiving or caring that though the fingers pointed forward like the toes, yet the thumb was now upon the *outer* border of the limb, and was thus made to correspond with the *little toe*.

We shall, I hope, be convinced that, in spite of the fact that the thumb and great toe have only *two joints*, the above is really the true relation so far as concerns them alone; but Vicq d'Azyr had no reason for thinking so, since the opinion upon this matter which, then as now, was nearly universal, is well expressed in these words of a later writer, "il est évident pour tout le monde que le pouce est l'analogue* du gros orteil." Vicq d'Azyr seems rather to have been loth to enter into particulars, and really ignores the hand altogether; for it was doubtless the apparent parallelism between the foot and the hand in its ordinary state of pronation that induced him to force the whole limb into a similar relation by turning

* "It is evident to every one that the thumb is the analogue of the great toe." "Analogue" is here incorrectly used by Martins in the sense of "homologue"; in the correctly limited sense of the word, the thumb *is* the *analogue* of the great toe, but it is the *homologue* of the little toe.

the elbow forward ; but when he is obliged to take the arm of the opposite side, he seems to have lost all faith in the hand, and leaves it in a position which, though correct in so far as the thumb is made to correspond with the little toe, is inconsistent with his own theory, and inadmissible on account of the displacement of the whole limb. And here was his error, in supposing that a rational comparison of the limb involved not merely a dislocation and reversion of the arm, but a transposition to the opposite side of the body, the right arm being thus made to correspond with the left leg, and the left arm with the right leg. And while we honor the great anatomist, who, in attempting a comparison between different regions of the same individual, really originated a new kind of Comparative Anatomy, which is destined to fill a large place in future investigations, we must deplore the method he employed, a method repugnant alike to common sense and the respect we ought to entertain for the relations God has established between the different parts of the animal frame. And it is doubtless to this pernicious example of Vicq d'Azyr that we must ascribe the extraordinary liberties which some of his successors have taken with the limbs, forcing upon them their preconceived ideas, as if each had said, "if the facts do not accord with my theory, why, so much the worse for the facts."

It is hard for us to believe that the great Cuvier, whose masterly demonstrations of corresponding parts in different animals constituted an era in anatomical science, and at the same time furnished the basis for a true classification, could have been so blinded by his exclusive devotion to Final Causes, and by his dislike for the transcendental theories of St. Hilaire as, during at least the greater part

of his life, to have attached little value to the comparison with each other of parts of the same body; but we could wish that he had ignored the subject entirely, rather than that in 1835 he should have lent the weight of his authority to the views of Vicq d'Azyr, as is shown by the following passage: "C'est la droite d'une paire qu'il faut comparer à la gauche de l'autre."*

Blandin, like Vicq d'Azyr and Cuvier, let the hand and fingers alone, the thumb still remaining opposite the little toe; but, in 1846, this inconsistency was pointed out by Turenne, who, desirous of making all things as harmonious as possible, in imagination, *cuts off the two hands* a little above the wrist, and *transposes them*, which of course brings the thumb on the inner borders, and opposite the great toe (Fig. 1 and 5); nor is it, perhaps, surprising that he should have regarded this as an improvement upon the proceedings of Vicq d'Azyr, and we ought rather to be gratified that, after putting the left arm in place of the right, and again changing the hands, he did not see fit to invert the entire limb, fasten the fingers upon the shoulder-blade, and declare the end of the arm-bone to be homologous with the great toe. Indeed, the whole proceeding is so extraordinary, that, but for the gravity with which it is proposed, one would incline to regard it as a burlesque, intended to bring the original view into ridicule. Yet only ten years ago, the doctrine of Vicq d'Azyr was again, though we hope for the last time, revived.

The errors in this view consist in the assumptions:

1. That the thumb corresponds with the great toe.
2. That the two limbs are parallel.
3. That it is either necessary or proper to compare the arm of one side with the leg of the opposite side.

*"It is the right of one pair that should be compared to the left of the other."

Fig. 1.

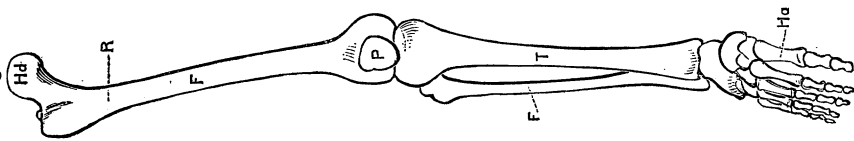


Fig. 2.

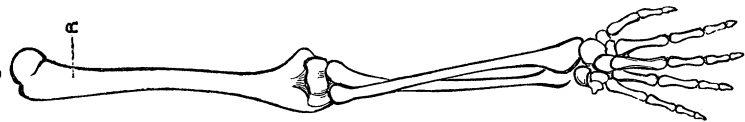


Fig. 3.

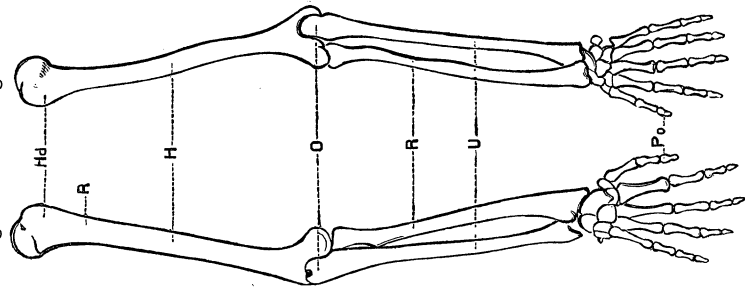


Fig. 4.

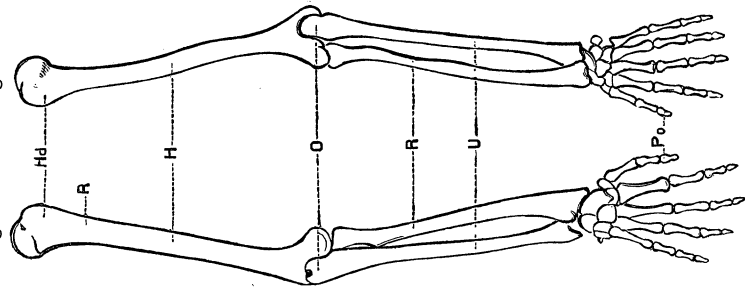


Fig. 5.

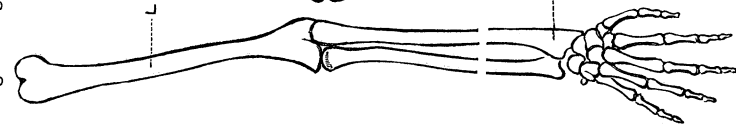


Fig. 6.

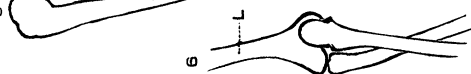
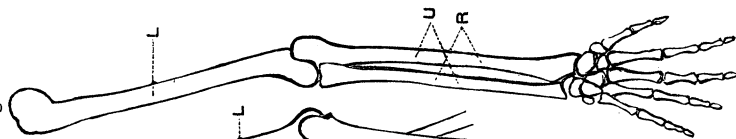


Fig. 7.



EXPLANATION OF PLATE 12.

The bones of the limbs are marked as in Plate 11. F, *Femur*, or thigh bone; T, *Tibia*; Fi, *Fibula*; Pa, *Patella*, or knee-pan; Ha, *Halter*, or great toe; H, *Humerus*, or arm bone; O, *Olecranon process* of elbow; U, *Ulna*; R, *Radius*; Po, *Pollex*, or thumb; Hd, *Head of Humerus*, or *Femur*.

Fig. 1. Bones of human leg, right side; the knee looks forward.

Fig. 2. Bones of human leg, right side; in the position in which Vicq d'Azyr began his comparison; the elbow looks backward, and the forearm is in pronation, the radius being crossed upon the ulna so as to leave the thumb on the inner side. (This and the three following figures are to be supposed *behind* Fig. 1, in order to be compared with it.)

Fig. 3. Right arm turned half way round so as to face the elbow forward like the knee; the hand remains as before, so that the forearm is untwisted, or supinated. The head of the Humerus now faces in the opposite direction to that of the Femur.

Fig. 4. Bones of *left* arm; all the parts agree with the leg except the thumb, which now comes on the *outer* side: this is as Vicq d'Azyr left it.

Fig. 5. This illustrates the comparison of Turenne. The upper parts of the limb are of the left arm as in Fig. 4; but the hand has been cut off and replaced by the right hand as in Fig. 3.

Fig. 6. Diagram of human foetus, showing the rudiments of limbs.

REVIEWS.

MANUAL OF THE BOTANY OF THE NORTHERN UNITED STATES, INCLUDING THE DISTRICT EAST OF THE MISSISSIPPI AND NORTH OF NORTH CAROLINA AND TENNESSEE. Arranged according to the Natural System. By *Asa Gray*, Fisher Professor of Natural History in Harvard University. Fifth Edition. With twenty-five plates, illustrating the Sedges, Grasses, Ferns, &c. New York: Ivison, Phinney, Blakeman, & Co. Chicago: S. C. Griggs & Co. 1867. pp. 701. [Not including the Mosses and Liverworts, nor the "Garden Botany."]

This new edition of the "Manual of Botany" is the result of the author's continuous desire to improve and make more perfect an early one (published in 1848) "hastily prepared to supply a pressing want."